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Assimilation of GNSS water vapour in WRF: a case study for Southern Germany

Andreas Wagner (1), Benjamin Fersch (1), Bettina Raible (2), and Harald Kunstmann (1)

(1) Karlsruhe Institute of Technology (KIT-Campus Alpin), Institute of Meteorology and Climate Research IMK-IFU, Garmisch-Partenkirchen, Germany (andreas.wagner3@kit.edu), (2) Karlsruhe Institute of Technology, Institute of Photogrammetry and Remote Sensing (IPF), Karlsruhe, Germany

The spatio-temporal distribution of water vapour is a major factor for the formation of clouds and generation of precipitation. State-of-the-art regional climate models do simulate water vapour in space and time though matching with reality is often unsatisfactory. Within the framework of the AtmoWater project we aim at obtaining an improved distribution of this meteorological variable by a data fusion approach. High-resolution information of water vapour in space (InSAR measurements) and time (GNSS station data) is assimilated into the regional climate model WRF and the coupled atmosphere-hydrological model WRF-Hydro. Tomographic techniques are used in addition to create a three-dimensional image of water vapour. Then, tomography and WRF simulations including assimilation are applied iteratively to gain best possible results for selected events, mainly from 2016 on. Furthermore, as a horizontal complement, ground-based infrared measurements from GLORIA can supplement the vertical measurements (InSAR, GNSS) for an event in October 2018. Our investigation area is in the south-western part of Germany (Upper Rhine Graben), encompassing an area of about 100 x 100 km^2 with a good coverage of X-band and C-band InSAR-measurements as well as GNSS stations.
We will present the concept of the AtmoWater project, in particular the assimilation of data in WRF. At the current stage, the 3DVAR assimilation system is used in a cycling mode to assimilate meteorological and GNSS station data into WRF at hourly interval. Preliminary results of GNSS water vapour assimilation with WRF and its impact on the spatial precipitation distributions will be presented.